

WHAT IS CLAIMED IS:

1. A mask comprising:

a first area including a first surrounding area in which a halftone phase shift film or a stacked film of a halftone phase shift film and an opaque film is provided on a transparent substrate, and a first opening area surrounded by the first surrounding area; and

a second area including a second surrounding area in which a halftone phase shift film is provided on the transparent substrate and a second opening area surrounded by the second surrounding area,

wherein a transparent film is provided in at least a part of the second opening area, the transparent film being configured to give a predetermined phase difference to exposure light passing through that part of the second opening area in which the transparent film is provided relative to exposure light passing through the second surrounding area.

2. The mask according to claim 1, wherein the transparent film comprises an SOG film.

3. The mask according to claim 1, wherein an absolute value of the predetermined phase difference is at least  $60^\circ$  and at most  $150^\circ$ .

4. The mask according to claim 1, wherein a phase difference between exposure light passing through the halftone phase shift film in the first surrounding area

and exposure light passing through the first opening area is  $180^\circ$  .

5        5. The mask according to claim 1, wherein the first opening area has substantially the same planar shape as that of the second opening area.

6. The mask according to claim 5, wherein the planar shape is like a rhomboid or a wedge.

10       7. The mask according to claim 1, wherein the first and second areas are provided outside a device pattern forming area.

8. A mask comprising:

15       a first area including a first surrounding area in which a halftone phase shift film or a stacked film of a halftone phase shift film and an opaque film is provided on a transparent substrate, and a first opening area surrounded by the first surrounding area; and

20       a second area including a second surrounding area in which a halftone phase shift film is provided on the transparent substrate and a second opening area surrounded by the second surrounding area,

25       wherein at least a part of the halftone phase shift film in the second surrounding area is thinner than the halftone phase shift film in the first surrounding area, and is configured to give a predetermined phase difference to exposure light passing through that part of the second surrounding

area which includes the thinner part of the halftone phase shift film relative to exposure light passing through the second opening area.

5        9. The mask according to claim 8, wherein an absolute value of the predetermined phase difference is at least  $60^\circ$  and at most  $150^\circ$  .

10       10. The mask according to claim 8, wherein a phase difference between exposure light passing through the halftone phase shift film in the first surrounding area and exposure light passing through the first opening area is  $180^\circ$  .

11. The mask according to claim 8, wherein the first opening area has substantially the same planar shape as that of the second opening area.

15       12. The mask according to claim 11, wherein the planar shape is like a rhomboid or a wedge.

13. The mask according to claim 8, wherein the first and second areas are provided outside a device pattern forming area.

20       14. A method of manufacturing a mask comprising:  
providing, in a first area, a first surrounding area in which a halftone phase shift film or a stacked film of a halftone phase shift film and an opaque film is provided on a transparent substrate and a first  
25       opening area surrounded by the first surrounding area, and, in a second area, a second surrounding area in which a halftone phase shift film is provided on the

transparent substrate and a second opening area  
surrounded by the second surrounding area; and

forming a transparent film in a selected area  
including at least a part of the second opening area,  
5 and giving a predetermined phase difference to exposure  
light passing through that part of the second opening  
area in which the transparent film is provided relative  
to exposure light passing through the second  
surrounding area.

10 15. The method according to claim 14, wherein  
forming the transparent film in the selected area  
includes dropping a material liquid for the transparent  
film in the selected area.

15 16. The method according to claim 14, wherein an  
absolute value of the predetermined phase difference is  
at least  $60^\circ$  and at most  $150^\circ$ .

20 17. The method according to claim 14, wherein a  
phase difference between exposure light passing through  
the halftone phase shift film in the first surrounding  
area and exposure light passing through the first  
opening area is  $180^\circ$ .

18. The method according to claim 14, wherein the  
first opening area has substantially the same planar  
shape as that of the second opening area.

25 19. The method according to claim 18, wherein the  
planar shape is like a rhomboid or a wedge.

20. The method according to claim 14, wherein the

first and second areas are provided outside a device pattern forming area.

21. A method of manufacturing a mask comprising:

5 providing, in a first area, a first surrounding area in which a halftone phase shift film or a stacked film of a halftone phase shift film and an opaque film is provided on a transparent substrate and a first opening area surrounded by the first surrounding area, and, in a second area, a second surrounding area in  
10 which a halftone phase shift film is provided on the transparent substrate and a second opening area surrounded by the second surrounding area; and

supplying an etching source to a selected area including at least a part of the second opening area to  
15 etch the transparent substrate in the selected area, and giving a predetermined phase difference to exposure light passing through that part of the second opening area which includes the etched part of the transparent substrate relative to exposure light passing through  
20 the second surrounding area.

22. The method according to claim 21, wherein supplying the etching source to the selected area includes dropping an etching liquid in the selected area.

25 23. The method according to claim 21, wherein supplying the etching source to the selected area includes supplying charged particles or electromagnetic

waves to the selected area.

24. The method according to claim 21, wherein an absolute value of the predetermined phase difference is at least  $60^\circ$  and at most  $150^\circ$ .

5        25. The method a mask according to claim 21, wherein a phase difference between exposure light passing through the halftone phase shift film in the first surrounding area and exposure light passing through the first opening area is  $180^\circ$ .

10        26. The method according to claim 21, wherein the first opening area has substantially the same planar shape as that of the second opening area.

27. The method a mask according to claim 26, wherein the planar shape is like a rhomboid or a wedge.

15        28. The method according to claim 21, wherein the first and second areas are provided outside a device pattern forming area.

29. A method of manufacturing a mask comprising:

20        providing, in a first area, a first surrounding area in which a halftone phase shift film or a stacked film of a halftone phase shift film and an opaque film is provided on a transparent substrate and a first opening area surrounded by the first surrounding area, and, in a second area, a second surrounding area in  
25        which a halftone phase shift film is provided on the transparent substrate and a second opening area surrounded by the second surrounding area; and

supplying an etching source to a selected area including at least a part of the second surrounding area to etch the halftone phase shift film in the selected area, and giving a first phase difference to exposure light passing through that part of the second surrounding area which includes the etched part of the halftone phase shift film relative to exposure light passing through the second opening area.

30. The method according to claim 29, wherein supplying the etching source to the selected area includes supplying charged particles or electromagnetic waves to the selected area.

31. The method according to claim 29, wherein an absolute value of the first phase difference is at least  $60^\circ$  and at most  $150^\circ$ .

32. The method according to claim 29, wherein a phase difference between exposure light passing through the halftone phase shift film in the first surrounding area and exposure light passing through the first opening area is  $180^\circ$ .

33. The method a mask according to claim 29, wherein the first opening area has substantially the same planar shape as that of the second opening area.

34. The method according to claim 33, wherein the planar shape is like a rhomboid or a wedge.

35. The method according to claim 29, wherein the first and second areas are provided outside a device

pattern forming area.

36. The method according to claim 29, further comprising supplying an etching source to a selected area including at least a part of the first opening area to etch the transparent substrate in the selected area, and giving a second phase difference to exposure light passing the first surrounding area relative to exposure light passing through that part of the first opening area which includes the etched part of the transparent substrate.

37. The method according to claim 36, wherein an absolute value of the first phase difference and an absolute value of the second phase difference are each at least  $60^\circ$  and at most  $150^\circ$ , and the first phase difference and the second phase difference have different signs.

38. A method of manufacturing a semiconductor device comprising transferring a pattern to a semiconductor substrate using the mask according to claim 1.

39. A method of manufacturing a semiconductor device comprising transferring a pattern to a semiconductor substrate using the mask according to claim 8.

40. A method of manufacturing a semiconductor device comprising:

transferring a pattern provided on the mask



according to claim 1 to a substrate using an exposure apparatus;

determining sizes of a first mark pattern corresponding to the a first opening area and of a second mark pattern corresponding to the second opening area, the first mark pattern and the second mark pattern being included in the transferred pattern;

determining magnitude of defocus on the basis of the sizes;

adjusting a focus of the exposure apparatus on the basis of the magnitude of defocus; and

transferring the pattern provided on the mask to a semiconductor substrate using the exposure apparatus with its focus adjusted.

41. A method of manufacturing a semiconductor device comprising:

transferring a pattern provided on the mask according to claim 8 to a substrate using an exposure apparatus;

determining sizes of a first mark pattern corresponding to the first opening area and of a second mark pattern corresponding to the second opening area, the first mark pattern and the second mark pattern being included in the transferred pattern;

determining magnitude of defocus on the basis of the sizes;

adjusting a focus of the exposure apparatus on the

basis of the magnitude of defocus; and

transferring the pattern provided on the mask to a semiconductor substrate using the exposure apparatus with its focus adjusted.

5        42. A method of manufacturing a semiconductor device comprising transferring a pattern to a semiconductor substrate using the mask formed by the method according to claim 14.

10       43. A method of manufacturing a semiconductor device comprising transferring a pattern to a semiconductor substrate using the mask formed by the method according to claim 21.

15       44. A method of manufacturing a semiconductor device comprising transferring a pattern to a semiconductor substrate using the mask formed by the method according to claim 29.

45. A method of manufacturing a semiconductor device comprising:

20       transferring a pattern provided on the mask manufactured by the method according to claim 14, to a substrate using an exposure apparatus;

25       determining sizes of a first mark pattern corresponding to the first opening area and of a second mark pattern corresponding to the second opening area, the first mark pattern and the second mark pattern being included in the transferred pattern;

determining magnitude of defocus on the basis of

the sizes;

adjusting a focus of the exposure apparatus on the basis of the magnitude of defocus; and

transferring the pattern provided on the mask to a semiconductor substrate using the exposure apparatus with its focus adjusted.

46. A method of manufacturing a semiconductor device comprising:

transferring a pattern provided on the mask manufactured by the method according to claim 21, to a substrate using an exposure apparatus;

determining sizes of a first mark pattern corresponding to the first opening area and of a second mark pattern corresponding to the second opening area, the first mark pattern and the second mark pattern being included in the transferred pattern;

determining magnitude of defocus on the basis of the sizes;

adjusting a focus of the exposure apparatus on the basis of the magnitude of defocus; and

transferring the pattern provided on the mask to a semiconductor substrate using the exposure apparatus with its focus adjusted.

47. A method of manufacturing a semiconductor device comprising:

transferring a pattern provided on the mask manufactured by the method according to claim 29, to a

substrate using an exposure apparatus;

determining sizes of a first mark pattern  
corresponding to the first opening area and of a second  
mark pattern corresponding to the second opening area,  
5 the first mark pattern and the second mark pattern  
being included in the transferred pattern;

determining magnitude of defocus on the basis of  
the sizes;

adjusting a focus of the exposure apparatus on the  
10 basis of the magnitude of defocus; and

transferring the pattern provided on the mask to a  
semiconductor substrate using the exposure apparatus  
with its focus adjusted.